



NIH Toolbox
Assessment of Neurological and Behavioral Function

"Toolbox Measures and Neurobiological Processes"

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For more information, please visit www.nihtoolbox.org
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Toolbox Overview



- ◆ Four domains:
 - 1) Sensation (6 subdomains)
 - 2) Motor
 - 3) Cognition
 - 4) Emotion
- ◆ Where possible, use extant instruments; but, some new instruments may be developed or old ones extended
- ◆ Life span focus
- ◆ Goal: Adherence to the construct being measured

Was Toolbox development informed by neurobiological processes?



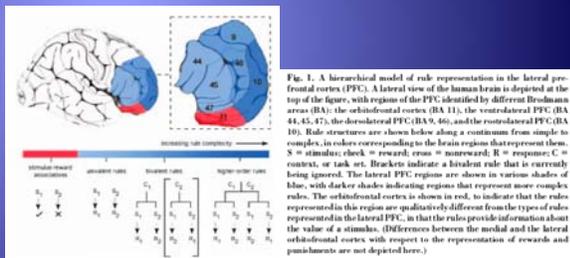
- ◆ Yes, to the extent possible.
- ◆ Sensory, motor domains: Relatively straightforward
- ◆ Cognitive domains: Targeted emphasis on measures with neuroimaging data and/or informative results from clinical populations to help validation
- ◆ Linkages between brain circuits and specific tasks
- ◆ Goal: Measure the full range of population-based performance

Cognitive Domain: Example (1)



- ◆ Zelazo & associates, executive function - cognitive flexibility
- ◆ Dimensional Change Card Sort (DCCS)
- ◆ Role of different areas of PFC in implementing increasingly complex rules
- ◆ Developed for toddlers & pre-school age children
- ◆ Quick, easy to administer
- ◆ Also being scaled up for older age levels

PFC Areas in Rule Development



Bunge & Zelazo, *Current Directions in Psychological Science*, 2008, 18, 118 - 121.

Cognitive Domain: Example (2)



- ◆ Bauer, Imitation-Based Assessment of Learning (IBAM)
- ◆ Developed for infants
- ◆ Developmental sensitivity
- ◆ Being scaled up for older age levels

Emotion Domain



- ◆ Emotion, mood, social cognition: Based on neurobiological processes to the extent possible given current knowledge
- ◆ So far, more difficult to tie to specific neural circuits
- ◆ Four sub-domains:
 - ◆ – Negative Affect
 - ◆ – Positive Affect
 - ◆ – Stress and Coping
 - ◆ – Social Relationships

Modern Emotion Theory: Temperamental Predispositions



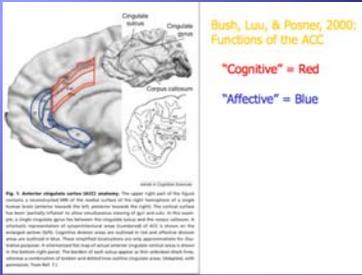
- ◆ Cf. modern temperament theories:
 - ◆ – Negative Affect
 - ◆ – Positive Affect
 - ◆ – Constraint (or, disinhibition)
- ◆ These map well onto neurophysiological circuits, broadly speaking

Brain Circuits in Temperament



- ◆ Negative affect: Fear (amygdala); anxiety (bed n. stria terminalis, increased CRF receptor density)
- ◆ Positive affect: Mesolimbic dopamine system, possibly also oxytocin systems esp. for social behavior
- ◆ Constraint: Anterior cingulate, PFC

Constraint: "Cognitive" and "Affective" Components of ACC



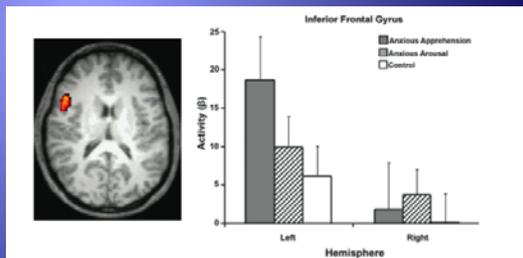
Bush, Luu, & Posner, *Trends in Cognitive Sciences*, 2000, 4, 215-222.

Emotions: New Construct Development



- Dimensional approaches (rather than discrete categories)
- Brain arousal/activation systems for aversive and for appetitive systems
- Brain measures have facilitated the validation of new constructs
- E.g., a new distinction of anxiety types:

Emotional Stroop: Anxious Apprehension.....



Engels, Heller, Mohanty, Herrington, Benich, Webb, & Miller, *Psychophysiology*, 2007, 44, 252-263.

Behavior vs. Neurobiology (2)



- ◆ The larger view: Behavior is the basis for natural selection processes in brain structure and function
- ◆ Therefore, it is necessary to study behavior in order to understand what the brain is doing
- ◆ Not simple 1:1 brain–behavior links, but behaviors that may reflect innumerable hormonal and neuronal, genetic and epigenetic (i.e., environmental) effects

Behavior vs. Neurobiology (2 - cont.)



- ◆ Some constructs, due to the brain's complexity, may remain very difficult to conceive in precise neurobiological terms but be very useful
- ◆ E.g., Life Satisfaction, Well-being:
- ◆ Might be: (1) High dopamine; (2) Low CRF; (3) High OXT; (4) High opioids; (5) High NPY; (6) Strong dorsal ACC; (7) Low sub-genu ACC [all, genetic & epigenetic] etc. etc.
- ◆ May be invaluable summaries for brains doing well; cf. Tolstoy's happy and unhappy families

Neurobiology and the Toolbox's Future



- ◆ Nevertheless, understanding how the brain implements behavior will remain a major goal
- ◆ Stepwise advances in behavior and neurobiology: Advances in one domain drive advances in the other
- ◆ Toolbox: Epidemiological studies to generate new behavioral & neurobiological hypotheses
- ◆ Perhaps, these will occasion the need for future refinements to the Toolbox –
- ◆ Better measures of extant constructs, BUT also new constructs



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